

# White Paper Report

Report ID: 107248

Application Number: PF5029012

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Institution: Minneapolis Society of Fine Arts

Reporting Period: 10/1/2012-6/30/2013

Report Due: 9/30/2013

Date Submitted: 9/27/2013

### **Project Activities**

Through a Sustaining Cultural Heritage Collections grant from the NEH, the Minneapolis Institute of Arts installed energy efficient LED lighting in its first and second floor galleries and some common areas between September 2012 and June 2013. The project team included Brian Kraft, Head of Registration; Karl Shapansky, Lighting Designer and Technician; Shawn McCann, Mechanical Maintenance and Utility Specialist; and Charles Walbridge, Photographer.

Through the grant, the MIA purchased 4,649 PAR38 and PAR30 Philips EnduraLED lamps for \$192,310 from Voss Lighting and installed them throughout the first and second floor, mostly in spaces where works of art are on display. These spaces include the print and drawing study room, the photography study room, the family center, seventy permanent collection galleries, and the Target galleries, which are the site of major traveling exhibitions. Designed by Mr. Shapansky to provide optimum color rendering, the new installation combines 2700 and 3000 Kelvin LED lamps in soft white and warm white. The bulbs maintain the light levels of the previous halogen lighting, which were established in consultation with the Midwest Art Conservation Center on the museum's campus, outside conservators, and curatorial colleagues.

The project period spanned nine months, from October 1, 2012, through June 30, 2013. In addition to installing the bulbs, MIA staff members repainted gallery walls to better accord with the new light quality. To minimize the impact of the installation on the public, they did much of the work on Mondays, when the museum is closed, and between gallery rotations and special exhibitions.

The project followed several years of research at the MIA and other institutions. Beginning in 2008-2009, MIA staff members tested LED lamps in spaces where no art was exhibited. While the tests (and research at other institutions, namely the Getty Research Institute) confirmed that the bulbs saved electricity, did not emit harmful ultraviolet (UV) or infrared (IR) rays, and significantly reduced heat output, it also revealed their poor color rendering and inconsistent quality. After manufacturers improved the bulbs in 2010-2011, the MIA conducted a second round of experiments to confirm that LEDs could be combined to produce an optimum viewing experience for art. Pleased with the results, the museum installed LEDs throughout its third floor, in part to be ready to provide tours of the galleries to visitors at the American Alliance of Museums annual conference in Minneapolis in May 2012, where team members Shawn McCann, Karl Shapansky, and Charles Walbridge made a presentation on the installation. Utility company incentive rebates helped to allay the initial cost of the bulbs, which are more expensive than their halogen counterparts. The grant to complete the installation began the following September.

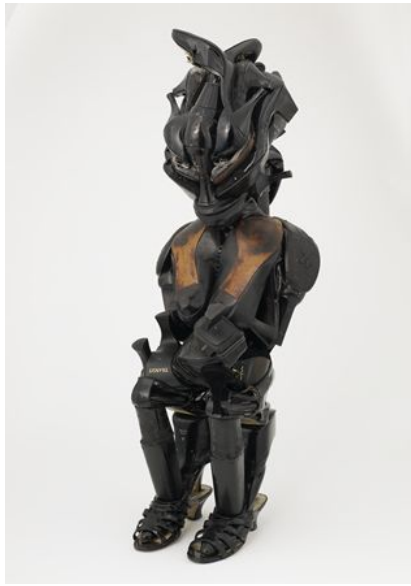
### **Accomplishments**

- Outcome 1: Safeguard the MIA's historically and culturally significant holdings for future generations by reducing damage to the works caused by UV and IR radiation and heat build-up in display cases.

As confirmed by research at major centers, such as the Getty Research Institute, LED lamps do not emit UV and IR radiation. Consequently, by operating them in its galleries, the museum is preserving light-sensitive works of art for future generations. These works include pieces that the public frequently asks to be on display, such as Dorothea Lange's *Migrant Mother*, which exposed the plight of farmers and sharecroppers during the Great Depression and greatly influenced the genre of documentary photography, and Willie Cole's contemporary sculpture *Ann Klein with a Baby in Transit*, constructed of high-heeled shoes to resemble a traditional African figure. The leather on the shoes is sensitive to the heat emitted by halogen lights. With LED lights in place, the MIA will be able to display the Cole sculpture in the newly reinstalled African galleries when they open in November 2013.



*Migrant Mother, Nipomo, California*  
Dorothea Lange, 1936



*Anne Klein with Baby in Transit*  
Willie Cole, 2009

The LED upgrade also ensures the safety of valuable works of art on loan to the MIA, including those that will come as part of special exhibitions on Matisse, Finnish design, Delacroix, and the arts of Islamic Africa. By making the MIA a more desirable destination for loaned art objects, LED lighting will help to secure opportunities for local audiences to view international masterpieces.

- Outcome 2: Create optimal aesthetic experiences of art

The examples below are simulations of how a painting looks under halogen lighting (left) and LED lighting (right). LED lighting provides significantly sharper details and richer colors. For example, on the painting by Constant Troyon, the halogen simulation looks yellow, like a varnish, while the LED simulation looks close to how the painting would appear in daylight. MIA visitors, in a blind test in the Impressionist paintings gallery in 2011-2012, preferred the look of art lit with LEDs over halogens, calling it more vibrant, with greater depth. In addition to better viewing, the LEDs apparently provide mood enhancement. Before the second floor was relit, MIA guards claimed to feel better working on the third floor, where the bulbs were already in use.



*Landscape with Cattle and Sheep*  
Constant Troyon, c. 1852-1858



*Landscape with Cattle and Sheep*  
Constant Troyon, c. 1852-1858





*View of Dresden: Schlossplatz*  
Ernst Ludwig Kirchner, 1926



*View of Dresden: Schlossplatz*  
Ernst Ludwig Kirchner, 1926



*Grainstack, Sun in the Mist*  
Claude Monet, 1891



*Grainstack, Sun in the Mist*  
Claude Monet, 1891

- Outcomes 3 and 4: Reduce the museum's energy expenses and impact on the environment

On par 38 lamps, LED lamps use 17 watts for every 90 watts a halogen lamp would use. On par 30 lamps, the ratio is 12 to 50 watts. Using a calculator on the website of E3 Living, the museum estimates that, by replacing par 30 and par 38 halogen bulbs with their LED counterparts on all three floors, it will save approximately \$117,288 and 500,000 watts per year (<http://e3living.com/cfl-savings-calculator>). Taking into account the vendor's bulk discount (lowering the average cost to \$41.37 per bulb) and the utility company's rebate of an average of \$14.02 on each LED bulb purchased, the final cost of each bulb is approximately \$27.35, which will be compensated in reduced electrical bills in eight to ten months. In addition, the bulbs should last up to eight years, about 22 times longer than halogens, decreasing the labor previously spent on replacing 65 to 75 halogen bulbs a week and allowing Mr. Shapanksy to focus on lighting design. "People have asked me, 'What are you going to do now that you've put yourself out of a job?'" he says. "The answer is that now I can really do my job!" These savings are good news for both the museum's Accounting

Department and its Green Team, which strives to reduce the museum's carbon footprint and nurture its environment through such strategies as keeping bees on the premises and maintaining a rain garden to filter run-off on its way to the nearby Mississippi River.

To publicize the project, the MIA published an article in *Verso*, its digital magazine ([http://contentviewer.adobe.com/s/Verso%20Magazine/032c48920fdf48f9809bf91de9afb345/FALL%202013/Light.html#page\\_lastPage](http://contentviewer.adobe.com/s/Verso%20Magazine/032c48920fdf48f9809bf91de9afb345/FALL%202013/Light.html#page_lastPage)). Titled "The Enlightened Museum," the piece explains the differences among halogen, fluorescent, CFL (compact fluorescent lamp), and LED (light-emitting diode) lighting; the advantages of LEDs; and the history of LEDs at the MIA, acknowledging the NEH for its role. Available for free from the App Store, *Verso* has consistently been featured in the site's highly coveted "What's Hot" category. Acclaimed by both users and critics, the magazine was downloaded 5,700 times in 43 countries in its first year. The publication won a 2013 Silver MUSE Award from the American Alliance of Museums and a Best App award at the International Design Communication Awards in Stockholm in July.

### **Audiences**

The first audience for the project is the community for which the MIA keeps in trust its collection of 86,000 works of art. In alignment with the museum's mission to enrich the community by collecting, preserving, and making accessible outstanding works of art from the world's diverse cultures, LED lighting will make possible the display of light-sensitive materials more frequently with greatly diminished risk of damage. Visitors to the museum, who number from 450,000 to 600,000 annually, are able to view art works—even fragile pieces that previously could seldom be exhibited—under lighting that freshly reveals their beauty and protects them from radiation. Further, the community benefits from the museum's reduction of its carbon footprint through decreased electricity use.

The second beneficiary of the project is the museum itself. In addition to saving money on electric bills, the museum is able to enjoy the prospect of its art being seen to its best advantage. It can also assure museums and private collectors that loaning their valuable pieces to the MIA will not expose them to damaging UV and IR light.

More broadly, the MIA has benefitted the museum and art conservation fields by leading the way in testing and installing LED lights. The Midwest Art Conservation Center eagerly followed the MIA's tests to determine if LEDs reveal conservation treatments on works of art (they do not). The center now works under LEDs while treating art. The Walker Art Center in Minneapolis consulted with the MIA and is in conversation with Voss Lighting to install LEDs. Reaching beyond a professional audience to the wider community, in August, 2013, KARE 11 television station in Saint Paul carried the story on *Simply Science*. The segment will soon be available on the website (<http://www.kare11.com/news/simplyscience/>). Minnesota Waste Wise has approached the MIA's Green Team for a blog post on the museum's conservation initiatives, including the bee hives, rain garden, and LEDc (<http://blog.mnwastewise.org/>). On the national level, the Lunder Conservation Center of the Smithsonian American Art Museum invited MIA project leader Brian Kraft to make a presentation at its March 1, 2013, symposium, Gallery Illumination: LED Lighting in Today's Museums. Mr. Kraft delivered his talk, "LED Lighting at the MIA: Process, Experience, and Results," in the company of experts from the United States and England. The symposium brochure is attached.

### **Evaluation**

The MIA did not carry out a formal evaluation of the project. Xcel Energy audited the museum to confirm that the bulbs were installed before issuing an energy rebate.

### **Continuation of the Project**

A few areas of the museum, such as period rooms fitted with non-standard lamp types, are waiting for LED bulbs to be developed for those fixtures. The museum will install them as they become available, or complete a lighting redesign to incorporate LEDs into the spaces. MIA staff is currently installing LEDs to light one of its signature pieces, Dale Chihuly's *Sunburst*, an enormous glass sculpture hanging in the museum's lobby.

The museum would like to continue its research by testing the potential advantages of installing motion-sensors on LEDs in galleries devoted to especially fragile works, such as master drawings and Asian works on paper and silk.

### **Grant Products**

The grant did not produce any material products.



*Sunburst*  
Dale Chihuly, 1999

### **Long Term Impact**

The grant has allowed the MIA to get ahead of the curve. As museums learn from the MIA's experience and gain confidence in LED lighting, demand for halogen Par38 Flood 130v and Par 50 30LWFL 130v bulbs diminishes. As a result, Phillips is discontinuing production of the lamps and filling orders for LED bulbs as fast as it can manufacture them (email from the vendor to Mr. Kraft, Sept 24, 2012). Further, as indicated by Mr. Kraft's inclusion in the Smithsonian symposium, the grant project has elevated the museum's reputation for innovation and positioned it to leverage funds for future projects.

### **Appendices**

Project Leader's Notes on "What We Learned about LEDs"

### **White Paper**

Please accept this report and appendix as the MIA's white paper.

### **“What We Learned about LEDs”**

Halogen to LED Lamp Conversion 2012-2013

Brian Kraft, Head of Registration

September 2012

#### Things to know about LEDs:

- LEDs have little to no ultraviolet (UV) or infrared radiation (IR) emissions; however, damage to light-sensitive art is still occurring within the visible light spectrum.
- LEDs have low heat emissions, making them a good choice for enclosed applications, eliminating or greatly reducing heat build-up in wall cases.
- LED lamps retrofit easily into our four different types of fixtures—Gotham, Edison Price, Nu-Lux, and Lightolier.
- LED lamps currently on the market have consistent and excellent color rendering and a high manufacture quality. In our total project order of over 5,200 lamps (during the pre-grant and grant periods), only 10-15 have not worked, and these were replaced by our lighting vendor.
- Potential users can estimate their cost savings here: <http://e3living.com/cfl-savings-calculator>

#### Decisions we made:

- We blended 2700K (Kelvin) and 3000K lamps and used screening to get the most desirable effect. We wanted to stay in a similar color range to what the galleries looked like with halogen lamps. We found that the 2700K LED produced a color close in appearance to halogen, but through testing we determined that mixing 2700Ks and 3000Ks produced a much better result. In the end, this blending may also lessen the appearance of color shift over time, keeping the light quality nearer to or above the quality we had originally with halogens.
- With the LED installation, we continue to use museum light levels that are standard for halogen lighting. We also continue to rotate light sensitive collections, but may allow a rotation to be on view for an additional 3 to 6 months depending on each case.
- We dated the back of each lamp with its installation date for guarantee purposes and possible future research.

#### Benefits:

- Having LEDs installed saves staff time. This time can now be focused on lighting design, and not just changing lamps; no need for daily rounds of the galleries! If there is a burn out, it is a halogen that was missed.
- In addition, previously averaged 65-75 burned-out halogen lamps a week (at times more), spending \$20,000-\$25,000/year on replacement lamps. This cost was eliminated.
- For our project, the high initial cost of the LED lamps was offset by a bulk discount from the manufacturer and a per lamp rebate from Xcel Energy company. Payback on our investment was calculated to take from 8-10 months.
- In the current market, the initial lamp cost is lower, while rebates are smaller from energy companies, but payback is still estimated to occur in under a year. Most major manufacturers offer 3-year guarantees.
- We are saving energy. On par 38 lamps, we are using 17 watts for every 90 watts a halogen lamp would use. On par 30 lamps, the ratio is 12 to 50 watts. Using a calculator on the website of E3 Living, the museum estimates that, by replacing par 30 and par 38 halogen



bulbs with their LED counterparts on all three floors, it will save approximately \$117,288 and 500,000 watts per year (<http://e3living.com/cfl-savings-calculator>).

- The lighting is great for looking at art. Blues and greens are more vibrant; gold frames and white marble sculptures pop off the wall and all sculptures and paintings appear to have more dimensionality.
- Even art that has been conserved looks good under LEDs. Initially conservators were concerned that old repairs would be easily identified when seen in the new light, but this is not the case. LEDs are now in the Midwest Art Conservation Center's labs.
- Staff enjoys working in spaces with LEDs, as the light feels brighter and crisper.

#### Trial and error:

- Cut screen inserts for can lights ahead of time, and lots of them. If possible mass produce them. This took a massive amount of man hours to trace and cut circles from screen, even with an electric scissors.
- Experiment with LEDs in your spaces to determine what sort of issues needed to be resolved and to gain acceptance by management, staff, curators, and conservators. In our case, early on management was skeptical of the technology and reluctant to spend so much to switch from halogen to LED. Testing, research, and improvements in the technology convinced them to move ahead.
- During testing we found that warm grey walls turned purple and required us to repaint many galleries; label paper and gallery signage were also impacted. White walls in our contemporary galleries had no effect.
- We thought replacing halogens would be a simple process of switching lamps in existing fixtures, but discovered that the LED beam reacted differently. It spread further on the wall and created a blotchy, textured effect. When we moved fixtures further away from the wall, more to the center of the gallery, this effect was reduced, or eliminated. This effect was most noticeable in galleries with lower ceilings of 12'.
- Be prepared to unpack lots of boxes. We recycled the cardboard and are reusing the Tyvek bags the lamps came in. You will need room for pallets, unpacking, and organization.
- The halogen lamps that were replaced by LED were reused as replacements elsewhere in the museum, saving the cost of new bulbs. Since the life expectancy of these lamps was shortened by handling and prior use, however, they required more frequent replacement and an increase in labor.

#### To be determined:

- LED lamps have a long life expectancy of 10-15 years with an estimated degradation of 20-30% over the life of the lamp. This degradation is due to the breaking down of phosphorus in the lamps and causes a shift in color. How much of a color shift, and what this means as to when lamps are replaced, has yet to be determined. Realistically, we are hoping to get up to 8 years from our LED lamps.
- Due to this color shift, the longer lamps are running for the same length of time in the same space, the harder it will be to replace a single lamp. We anticipate changing out entire galleries, when lamps need to be replaced, as it will most likely be very distracting and noticeable when a new lamp is placed among older ones.

We still have a few hundred extra halogen lamps, if anyone needs some. Please contact Brian Kraft at [bkraft@artsmia.org](mailto:bkraft@artsmia.org).